

**WHAT IS CLAIMED IS:**

1. A liquid crystal display, comprising:

a first insulating substrate having a top surface and a bottom surface;

a pixel electrode formed on the top surface of the first insulating substrate, the  
5 pixel electrode having a first opening pattern;

a second insulating substrate having a top surface and a bottom surface;

a common electrode formed on the bottom surface of the second insulating  
substrate, the common electrode having a second opening pattern; and

a liquid crystal layer sandwiched between the first substrate and the second  
substrates,

wherein the first opening pattern and the second opening patterns each have a  
middle linear portion, the linear portions being alternately arranged parallel to each other.

2. The liquid crystal display of claim 1, wherein the first opening pattern  
comprises a first opening formed in an upper region of the pixel electrode in a first  
direction and a second opening formed in a lower region of the pixel electrode in a  
second direction normal to the first direction, and the second opening pattern comprises  
a first trunk opening formed in a first region of the common electrode in the first  
direction and a second trunk opening formed in the second region of the common  
electrode in a second direction wherein the first region and the second region of the  
common electrode respectively correspond to the upper region and the lower region of  
the pixel electrode.

3. The liquid crystal display of claim 2, wherein the first direction is at a  
slant with respect to long sides or short sides of the pixel electrode.

4. The liquid crystal display of claim 3, wherein the second opening pattern further comprises first branch openings overlapping a first short side and a second short side of the pixel electrode and second branch openings overlapping a first long side and a second long side of the pixel electrode, and the first opening pattern further comprises a third opening formed where the upper and lower regions of the pixel electrode meet while proceeding parallel to the first short side and the second short side of the pixel electrode, the first opening pattern and the second opening patterns partitioning the pixel electrode into a plurality of sub-regions each shaped as a closed polygon.

5. The liquid crystal display of claim 4, wherein each of the second branch openings has a width greater than a width of the trunk opening portion.

6. The liquid crystal display of claim 2, wherein the first direction is parallel to one of the long side and the short side of the pixel electrode.

7. The liquid crystal display of claim 6, wherein each of the first trunk opening and the second trunk opening has opposite ends, each end having a gradually enlarged width.

8. The liquid crystal display of claim 6, wherein one of the second trunk opening overlaps the second short side of the pixel electrode.

9. The liquid crystal display of claim 6, wherein the first opening portion has opposite ends, each end having a gradually reduced width.

10. The liquid crystal display of claim 2, further comprising a first polarizer film formed on the bottom surface of the first substrate, and a second polarizer film formed on the top surface of the second substrate, the first polarizer film and the second

polarizer film being arranged to have polarizing directions of 45° with respect to the first direction and the second direction, respectively.

11. The liquid crystal display of claim 2, wherein the pixel electrode has protrusions at portions adjacent to the ends of the first opening and the second opening.

5 12. The liquid crystal display of claim 1, wherein the opening width of the first opening pattern and the second opening pattern is in the range of 10-16 $\mu$ m

13. A liquid crystal display, comprising:

a first insulating substrate having a top surface and a bottom surface,

a pixel electrode formed on the top surface of the first insulating substrate, and the pixel electrode having a first opening pattern;

a second insulating substrate having a top surface and a bottom surface;

a common electrode formed on the bottom surface of the second insulating substrate, the common electrode having a second opening pattern;

a liquid crystal layer sandwiched between the first substrate and the second substrate,

wherein the first opening pattern and the second opening pattern overlap each other to thereby partition the pixel electrode into a plurality of sub-regions, each sub-region being polygonal in shape with two longest sides proceeding parallel to each other.

14. The liquid crystal display of claim 13, wherein the sub-regions of the pixel electrode are classified into a first-type that has the longest sides arranged in a first direction, and a second-type that has the longest sides arranged in a second direction normal to the first direction.

15. The liquid crystal display of claim 14, wherein the first direction is at a slant with respect to long or short sides of the pixel electrode.

16. The liquid crystal display of claim 14, wherein the first direction is parallel to one of long and short sides of the pixel electrode.

5 17. The liquid crystal display of claim 13, wherein the opening width of the first opening pattern and the second opening pattern is in the range of 10-16 $\mu$ m

18. A liquid crystal display, comprising:  
a first insulating substrate having a top surface and a bottom surface;  
a pixel electrode formed on the top surface of the first insulating substrate, the pixel electrode having a first opening pattern;

a second insulating substrate having a top surface and a bottom surface;  
a common electrode formed on the bottom surface of the second insulating substrate, the common electrode having a second opening pattern; and

a liquid crystal layer sandwiched between the first substrate and the second substrate while contacting the pixel electrode and the common electrode,

wherein the first opening pattern and the second opening pattern generate fringe fields when voltage is applied between the pixel electrode and the common electrode, and the orienting direction of the liquid crystal molecules due to fringe fields corresponds to the orienting direction of the liquid crystal molecules resulting from a force exerted by molecules.

20 19. The liquid crystal display of claim 18, wherein the liquid crystal molecules are oriented in four directions due to the fringe fields.

20. The liquid crystal display of claim 18; wherein the opening width of the first opening pattern and the second opening pattern is in the range of 10-16 $\mu$ m

21. A liquid crystal display, comprising:

a first insulating substrate having a top surface and a bottom surface;

5 a pixel electrode formed on the top surface of the first insulating substrate, the pixel electrode having a first opening pattern at each pixel area, the pixel electrode with the first opening pattern being substantially rectangular in shape in each pixel area and having (a) a first long side and a second long side, (b) a first short side and a second short side, (c) an upper region corresponding to roughly half of the pixel electrode defined by the first long side and the second long side and the first short side, and (d) a lower region corresponding to roughly half of the pixel electrode defined by the first long side and the second long side and the second short side;

a second insulating substrate having a top surface and a bottom surface;

a common electrode formed on the bottom surface of the second insulating substrate, the common electrode having a second opening pattern at each pixel area, the common electrode with the second opening pattern being substantially rectangular in shape in each pixel area and having (a) a third long side and a fourth long side, (b) a third short side and a fourth short side, (c) an upper region corresponding to roughly half of the common electrode defined by the third long side and the fourth long side and the third short side, and (d) a lower region corresponding to roughly half of the pixel electrode defined by the third long side and the fourth long side and the fourth short side; and

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a liquid crystal layer sandwiched between the first substrate and the second substrate while contacting the pixel electrode and the common electrode,

wherein the first opening pattern comprises a first opening proceeding from the first long side in a direction toward the second long side, second and third openings proceeding from the second long side at a predetermined incline toward the first long side, the second and third openings being symmetrical with respect to the first opening,

wherein the second opening pattern comprises fourth to sixth openings, the fourth opening comprising a trunk proceeding in a direction horizontal to the first and second short sides, first and second branches branched from the trunk toward the first long side slightly up and downwards, and first and second sub-branches respectively extended from the first and second branches opposite each other in a direction parallel to the first and second long sides, the fifth opening portion comprising a body parallel to the first branch, and first and second limbs extended from top and bottom ends of the body respectively in directions parallel and perpendicular to the first and second short sides, the sixth opening portion being symmetrical to the fifth opening portion with respect to the fourth opening portion, and wherein the first and second opening patterns are alternately arranged when viewed from above.

22. The liquid crystal display of claim 21, wherein the first and second sub-branches, and the second limbs have a width greater than a width of other portions of the second opening pattern.

23. The liquid crystal display of claim 21, further comprising a first polarizer film formed on the bottom surface of the first substrate, and a second polarizer film formed on the top surface of the second substrate, the first and second polarizer

films being polarized either in the horizontal and vertical directions or in the vertical and horizontal directions.

24. The liquid crystal display of claim 22, further comprising a first polarizer film formed on the bottom surface of the first substrate, and a second polarizer film formed on the top surface of the second substrate, the first and second polarizer films being polarized either in the horizontal and vertical directions or in the vertical and horizontal directions.

25. The liquid crystal display of claim 21, wherein the width of the first to sixth openings is in the range of 10-16 $\mu$ m

26. The liquid crystal display of claim 22, wherein the width of the first to sixth openings is in the range of 10-16 $\mu$ m

27. A liquid crystal display, comprising:

a first insulating substrate having a top surface and a bottom surface;

a pixel electrode formed on the top surface of the first insulating substrate, the pixel electrode having a first opening pattern at each pixel area, the pixel electrode with the first opening pattern being substantially rectangular in shape in each pixel area and having (a) a first long side and a second long side, (b) a first short side and a second short side, (c) a first corner and a fourth corner formed respectively by ends of the first short side and the first long side and by the second short side and the first long side, (d) a second corner and a third corner respectively formed by the first short side and the second long side and by the second short side and the second long side, (e) an upper region corresponding to roughly half of the pixel electrode defined by the first and second long sides and the first short side, and (f) a lower region corresponding to

roughly half of the pixel electrode defined by the first and second long sides and the second short side;

a second insulating substrate having a top surface and a bottom surface;

5 a common electrode formed on the bottom surface of the second insulating substrate, the common electrode having a second opening pattern at each pixel area, the common electrode with the second opening pattern being substantially rectangular in shape in each pixel area and having (a) a third long side and a fourth long side, (b) a third short side and a fourth short side, (c) an upper region corresponding to roughly half of the common electrode defined by the third long side and the fourth long side and the third short side, and (d) a lower region corresponding to roughly half of the pixel electrode defined by the third long side and the fourth long side and the fourth short side; and

a liquid crystal layer sandwiched between the first substrate and the second substrate while contacting the pixel electrode and the common electrode,

wherein the first opening pattern comprises a first opening, the first opening comprising a first inclined line proceeding from the first long side toward the second long side, and a second inclined line extended from the first inclined line toward the first long side,

20 wherein the second opening pattern comprises second and third openings, the second opening comprising a base proceeding in a direction parallel to the first long side and the second long side, and a projection extended from the base in a direction parallel to the first short side and the second short side, the third opening comprising a body proceeding in a direction parallel to the first short side and the second short side, and a



first limb and a second limb extended from a top end and a bottom end of the body at a predetermined incline while being symmetrical to each other with respect to the second opening, and

wherein the first opening pattern and the second opening pattern are alternately arranged when viewed from above.

28. The liquid crystal display of claim 27, further comprising a first polarizer film formed on the bottom surface of the first substrate, and a second polarizer film formed on the top surface of the second substrate, the first polarizer film and the second polarizer film having polarizing directions either in the horizontal direction and the vertical direction or in the vertical direction and the horizontal direction.

29. The liquid crystal display of claim 27, wherein a distance from the first opening to the third opening is in the range of 10-16 $\mu$ m

30. The liquid crystal display of claim 25, (wherein a distance from the first opening to the third opening is in the range of 10-16 $\mu$ m

31. The liquid crystal display of claim 27, wherein the second top and bottom edges of the pixel electrode, and edges of the pixel electrode where the base and the projection meet are cut away.

32. The liquid crystal display of claim 28, wherein the second top and bottom edges of the pixel electrode, and edges of the pixel electrode where the base and the projection meet are cut away.

33. A liquid crystal display, comprising:

a first insulating substrate having a top surface and a bottom surface;

a pixel electrode formed on the top surface of the first insulating substrate, the pixel electrode having a first opening pattern at each pixel area, the pixel electrode with the first opening pattern being substantially rectangular in shape and having (a) a first long side and a second long side, (b) a first short side and a second short side, (c) a first corner and a fourth corner formed respectively by ends of the first short side and the first long side and by the second short side and the first long side, (d) a second corner and a third corner formed respectively by the first short side and the second long side and by the second short side and the second long side, (e) an upper region corresponding to roughly half of the pixel electrode defined by the first long side and the second long side and the first short side, and (f) a lower region corresponding to roughly half of the pixel electrode defined by the first long side and the second long side and the second short side;

a second insulating substrate having a top surface and a bottom surface;

a common electrode formed on the bottom surface of the second insulating substrate, the common electrode having a second opening pattern at each pixel area, the common electrode with the second opening pattern being substantially rectangular in shape in each pixel area and having (a) a third long side and a fourth long side, (b) a third short side and a fourth short side, (c) an upper region corresponding to roughly half of the common electrode defined by the third long side and the fourth long side and the third short side, and (d) a lower region corresponding to roughly half of the pixel electrode defined by the third long side and the fourth long side and the fourth short side; and

a liquid crystal layer sandwiched between the first substrate and the second substrate while contacting the pixel electrode and the common electrode,

wherein the first opening pattern comprises a first opening hollowed from the first long side and extending toward the second long side in a direction parallel to the first short side and the second short side, and a second opening hollowed from the second long side and extending toward the first long side parallel to the first opening,

wherein the second opening pattern comprises a third opening, the third opening comprising a first inclined line proceeding in a first direction, a second inclined line extending from the first inclined line in a second direction opposite to the first direction, and a third inclined line extending from the second inclined line parallel to the first inclined line, and

wherein the first and second openings partition the pixel electrode into three separate regions, and the third opening partitions each region of the pixel electrode into two sub-regions.

34. The liquid crystal display of claim 33, further comprising a first polarizer film formed on the bottom surface of the first substrate, and a second polarizer film formed on the top surface of the second substrate, the first and second polarizer films having polarization directions either of 45° and 135° or of 135° and 45° with respect to the short sides of the pixel electrode.

35. The liquid crystal display of claim 33, wherein a distance between the first opening and the third opening is in the range of 10-16 $\mu$ m

36. The liquid crystal display of claim 34, wherein a distance between the first opening and the third opening is the range of 10-16  $\mu$ m

37. The liquid crystal display of claim 33, wherein edges of the pixel electrode at inlet areas of the first and second openings as well as the second corner and the third corner of the pixel electrode are cut away.

38. The liquid crystal display of claim 34, wherein edges of the pixel electrode at inlet areas of the first and second openings as well as the second corner and the third corner of the pixel electrode are cut away.

39. A liquid crystal display, comprising:

a first insulating substrate having a top surface and a bottom surface;

a pixel electrode formed on the top surface of the first insulating substrate, the pixel electrode having a first opening pattern at each pixel area, the pixel electrode with the first opening pattern being substantially rectangular in shape and having long sides and short sides;

a second insulating substrate having a top surface and a bottom surface;

a common electrode formed on the bottom surface of the second insulating substrate, the common electrode having a second opening pattern at each pixel area, which correspond to each pixel area of the pixel electrode; and

a liquid crystal layer sandwiched between the first substrate and the second substrates while contacting the pixel electrode and the common electrode,

wherein the first opening pattern comprises a plurality of linear openings spaced apart at a predetermined distance and arranged in parallel in a direction parallel to the long sides,

wherein the second opening pattern comprises a plurality of X-shaped openings spaced apart from each other at a predetermined distance and arranged in parallel in a direction parallel to the long sides, and

wherein the first opening pattern partitions the pixel electrode into a plurality of regions, and the second opening pattern partitions each region of the pixel electrode into four sub-regions.

40. The liquid crystal display of claim 39, further comprising a first polarizer film formed on the bottom surface of the first substrate, a second polarizer film formed on the top surface of the second substrate, the first polarizer film and the second polarizer film having polarizing direction either of 45° and 135° or of 135° and 45° with respect to the short sides of the pixel electrode.

41. The liquid crystal display of claim 39, wherein the width of the openings of the first opening pattern and the second opening pattern is in the range of 10 to 16μm

42. The liquid crystal display of claim 40, wherein the width of the openings of the first opening pattern and the second opening pattern is in the range of 10 to 16μm.

43. A liquid crystal display, comprising:

a first insulating substrate having a top surface and a bottom surface;

a pixel electrode formed on the top surface of the first insulating substrate, the pixel electrode having a first opening pattern at each pixel area, the pixel electrode with the first opening pattern being substantially rectangular in shape in each pixel area and having a first long side and a second long side, a first short side and a second short side,

an upper region corresponding to roughly half of the pixel electrode defined by the first long side and the second long side and the first short side, and a lower region corresponding to roughly half of the pixel electrode defined by the first long side and the second long side and the second short side;

5 a second insulating substrate having a top surface and a bottom surface;

a common electrode formed on the bottom surface of the second insulating substrate, the common electrode having a second opening pattern at each pixel area, which correspond to each pixel area of the pixel electrode; and

a liquid crystal layer sandwiched between the first substrate and the second substrate while contacting the pixel electrode and the common electrode,

wherein the first opening pattern comprises a first opening proceeding in a direction parallel to the first long side and the second long side, and second openings positioned under the first opening portion while proceeding in a direction parallel to the first short side and the second short side, the second opening partitioning the pixel electrode into the upper region and the lower region,

wherein the second opening pattern comprises third openings proceeding in a direction parallel to the first long side and the second long side, and fourth openings positioned below the third opening while proceeding in a direction parallel to the first short side and the second short side,

20 wherein the first opening and the third opening are alternately arranged while partitioning the upper region of the pixel electrode into a plurality of sub-regions in a direction parallel to the first long side and the second long side, and the second opening and the fourth opening are alternately arranged while partitioning the lower region of the

pixel electrode into a plurality of sub-regions in a direction parallel to the first short side and the second short side.

44. The liquid crystal display of claim 43, wherein the fourth opening closest to the second short side overlap the second short side of the pixel electrode.

5 45. The liquid crystal display of claim 43, wherein both ends of the fourth openings have a gradually enlarged width.

46. The liquid crystal display of claim 43, wherein a bottom end of the first opening has a gradually reduced width.

47. The liquid crystal display of claim 43, further comprising a first polarizer film formed on the bottom surface of the first substrate, and a second polarizer film formed on the top surface of the second substrate, the first polarizer film and the second polarizer film having polarizing directions either of 45° and 135° or of 135° and 45° with respect to the short sides of the pixel electrode.

48. The liquid crystal display of claim 43, wherein the width of the first through the fourth openings is in the range of 10 to 16 $\mu$ m

49. A liquid crystal display, comprising:

a first insulating substrate having a top surface and a bottom surface;

a pixel electrode formed on the top surface of the first insulating substrate, the pixel electrode having a first opening pattern at each pixel area, the pixel electrode with the first opening pattern being substantially rectangular in shape in each pixel area and having (a) a first long side and a second long side, (b) a first short side and a second short side, (c) an upper region corresponding to roughly half of the pixel electrode defined by the first long side and the second long side and the first short side, and (d) a

lower region corresponding to roughly half of the pixel electrode defined by the first long side and the second long side and the second short side;

a second insulating substrate having a top surface and a bottom surface;

a common electrode formed on the bottom surface of the second insulating substrate, the common electrode having a second opening pattern at each pixel area, the common electrode with the second opening pattern being substantially rectangular in shape in each pixel area and having (a) a third long side and a second long side, (b) a first short side and a second short side, (c) an upper region corresponding to roughly half of the common electrode defined by the third long side and the fourth long side and the third short side, and (d) a lower region corresponding to roughly half of the pixel electrode defined by the third long side and the fourth long side and the fourth short side; and

a liquid crystal layer sandwiched between the first substrate and the second substrate while contacting the pixel electrode and the common electrode,

wherein the first opening pattern comprises a first linear opening proceeding in a direction parallel to the first short side and the second short side,

wherein the second opening pattern comprises a second opening proceeding in a direction parallel to the first long side and the second long side, and a third opening positioned away from the second opening toward the second short side and proceeding in a direction parallel to the first short side and the second short side, and

wherein the second opening bisects the upper region of the pixel electrode into left and right sub-regions, and the first and third openings partition the lower region of the pixel electrode into a plurality of sub-regions.



50. The liquid crystal display of claim 49, wherein a top end of the second opening portion, and both ends of the third opening portion have a gradually enlarged width.

51. The liquid crystal display of claim 49, wherein the third opening overlaps the second short side of the pixel electrode.

52. The liquid crystal display of claim 49, further comprising a first polarizer film formed on the bottom surface of the first substrate, and a second polarizer film formed on the top surface of the second substrate, the first polarizer film and the second polarizer film having polarizing directions either of 45° and 135° or of 135° and 45° with respect to the short sides of the pixel electrode.

53. The liquid crystal display of claim 49, wherein the width of the first through the third openings is in the range of 10 to 16μm.

54. A liquid crystal display, comprising:

a first insulating substrate having a top surface and a bottom surface;

a pixel electrode formed on the top surface of the first insulating substrate, the pixel electrode at each pixel area being shaped with a plurality of ovals continuously interconnected in a vertical direction;

a second insulating substrate having a top surface and a bottom surface;

a common electrode formed on the bottom surface of the second insulating substrate, the common electrode having an opening pattern at each pixel area, which corresponds to each pixel area of the pixel electrode; and

a liquid crystal layer sandwiched between the first substrate and the second substrate while contacting the pixel electrode and the common electrode,

wherein the opening pattern comprises first diamond-shaped openings spaced apart from each other at a predetermined distance in a longitudinal direction, and second openings and third openings externally surrounding the first diamond-shaped openings,

5 wherein the region of the common electrode defined by inner sides of the second opening and the third opening facing the diamond-shaped opening portion being formed with oval-shaped portions, each oval-shaped portion surrounding one of the diamond-shaped openings, and

wherein each of the first diamond-shaped openings is positioned at each oval-shaped portion of the pixel electrode when viewed from above, and the second openings and the third openings surround the pixel electrode.

55. The liquid crystal display of claim 54, further comprising a first polarizer film formed on the bottom surface of the first substrate, and a second polarizer film formed on the top surface of the second substrate, the first polarizer film and the second polarizer film having polarizing directions either in the longitudinal direction and perpendicular to the longitudinal direction.

56. The liquid crystal display of claim 54, wherein a distance from the second opening and the third opening to an outer side of the pixel electrode is uniformly in the range of 10-16 $\mu$ m.

57. The liquid crystal display of claim 55, further comprising a first  
20 compensation film attached between one of the substrates and one of the polarizer films attached thereto.

58. The liquid crystal display of claim 57, wherein the first compensation film is a biaxial compensation film.

59. The liquid crystal display of claim 58, wherein a slow axis of the first compensation film is parallel or perpendicular to the polarizing directions of the polarizer films.

60. The liquid crystal display of claim 57, further comprising a second compensation film attached between one of the substrates and one of the polarizer films attached thereto.

61. The liquid crystal display of claim 60, wherein the first compensation film and the second compensation film are respectively an a-plate compensation film and a c-plate compensation film.

62. The liquid crystal display of claim 61, wherein a slow axis of the a-plate compensation film is parallel with the polarizing directions of the polarizer film.

63. The liquid crystal display of claim 61, wherein a slow axis of the a-plate compensation film is perpendicular to the polarizing directions of the polarizer film.

64. A substrate for a liquid crystal display, comprising:

a pixel electrode having a saw shape aperture; and

a wiring overlapping the aperture.

65. The substrate of claim 64, wherein the wiring is a gate wiring.

66. A substrate for a liquid crystal display, comprising:

a common electrode having a saw shape aperture; and

a black matrix overlapping the aperture.

67. A liquid crystal display, comprising:

a first substrate including a pixel electrode having a first saw shape aperture;

and

a second substrate opposite the first substrate, the second substrate including a black matrix and a common electrode having a second saw shape aperture that is parallel and alternate to the first aperture,

wherein the black matrix includes a first portion overlapping the second aperture, a second portion put across bent points of the first and the second saw shape aperture and a third portion covering a portion where the first aperture and the second aperture meet a boundary of the pixel electrode.

68. The liquid crystal display of claim 67, further comprising a wiring overlapping the first aperture on the first substrate.

69. The liquid crystal display of claim 68, wherein the wiring is a gate wiring.

70. The liquid crystal display of claim 67, wherein the black matrix further includes a fourth portion overlapping the first aperture.

71. The liquid crystal display of claim 67, wherein the third portion of the black matrix is a triangular shape.